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Performance Analysis of H-Bridge Inverter Integrated For Renewable Energy Sources

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Abstract— An optimized third harmonic compensation strategy is proposed to improve the linear modulation range of single-phase inverter. The method injects the minimum amount of positive third harmonic into inverter by keeping modulation waveform amplitudes of over-modulation cells just being unity, then compensates same amount of negative third harmonic and properly distributes it to the normal cell. It has been observed and the simulation results are discussed. The two-level inverter has the lowest cost and weight in comparison with the other topologies. Hence it has very high THD and it is not practical to have an output voltage with high such THD. The design of the 5-level multilevel inverters seems to be better than the inverters. The proposed method is verified by the combination of battery storage power, capacitor bank and the solar PV Cell.

Keywords- *Cascaded H-Bridge, PLL, SOC, MPPT, SVPWM, DSPWM*

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I. INTRODUCTION

The use of renewable energy increased greatly just after the first big oil crisis in the late seventies. At that time, economic issues were the most important factors, hence interest in such processes decreased when oil prices fell. The current resurgence of interest in the use of renewable energy is driven by the need to reduce the high environmental impact of fossil-based energy systems. Harvesting energy on a large scale is undoubtedly one of the main challenges of our time. Future energy sustainability depends heavily on how the renewable energy problem is addressed in the next few decades.

Although in most power-generating systems, the main source of energy (the fuel) can be manipulated, this is not true for solar and wind energies. The main problems by using this energy source is cost and availability: wind and solar power are not always available where and when needed. Unlike conventional sources of electric power, these renewable sources are not “dispatchable” and the power output cannot be controlled. Daily and seasonal effects and limited predictability result in intermittent generation. Smart grids promise to facilitate the integration of renewable energy and will provide other benefits as well.

Researchers are focus to overcome a number of technical issues to deliver renewable energy in significant quantities. Control techniques are one of the key enabling technologies for the deployment of renewable energy systems. The maximum utilization of solar and wind power, it require effective control techniques. In addition, smart grids cannot be achieved without extensive use of control technologies at all levels.

A few control techniques have been proposed for CHB-based PV frameworks to satisfy the assignment of current controlling and MPPT [1]-[4]. The procedures in [1],[2] can accomplish control objectives, yet they don't consider the framework conduct under non-perfect conditions. In [3], an adjusted MPPT plot is displayed to enhance the framework execution under lopsided power conditions. Be that as it may, the strategy shifts activity purpose of the PV module with high yield control from maximum power point (MPP) toward the voltage source locale of I-V bend, bringing about low vitality gathering. A mixture tweak methodology is portrayed in [4]-[6], which utilizes low recurrence exchanging for voltage adjust of dc-interface capacitors and the high recurrence sinusoidal pulse width modulation (SPWM) for molding yield air conditioning current. It can expand straight working district of CHB inverter contrasted with SPWM, since the maximum modulation index (MI) of square wave is 4/π. notwithstanding, the strategy does not control dc-connect voltages precisely but rather balances them by charging or releasing dc-interface capacitors in view of the condition of framework, which could bother dc-connect voltages variance. A receptive power pay system is appeared in [5]-[7], which abuses the power factor as a level of opportunity to balance out the converter activity, yet the lower control factor may constrain its application [7].

II. OBJECTIVES

The main objective of the proposed method is to reduce the Total Harmonic Distortion in micro grids.

III. PROPOSED METHOD

The DC–DC converter has multiple input ports for connecting different sources, such as photovoltaic (PV) panels, wind turbine generators (WTGs), fuel cells, etc., The multiport DC-DC converter not only regulates the low-level DC voltages of the sources to a constant high level required by the inverter but also provides other important control functions, such as maximum power point tracking (MPPT). Figure 1 shows the block diagram of the hardware representation of the proposed system. Two input sources such as solar and wind, and a battery are connected to the converter. The operations of the switches are controlled through PWM signals these are generated by dsPIC controller. It generates error signals. These error signals compare the reference voltage with the actual voltage and generate PWM signals for switching operation. Then PWM

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signals are feds to the converter. The converter circuits controls the input voltage and boost the output voltage.

Solar cell –converted radiation energy in to electrical or thermal energy.

Ultra Capacitor – Compared to regular electrolytic capacitors, it holds a larger amount of energy. This energy density makes it possible to have thousands of farads in a single cell.

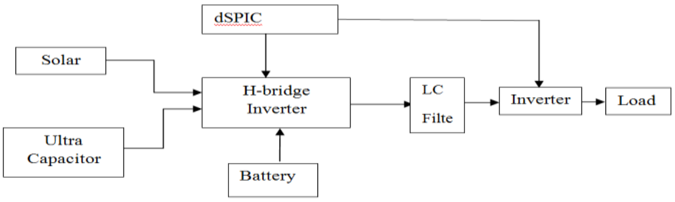

Figure – 1 Block Diagram for the proposed work

Battery – is used to charge and discharge the energy. This research is used fourteen 3.7V lithium ion polymer batteries. It required 21 Amp-hours to power a 1000W load (it is usually a good idea to add 10 to 20% to the calculated amp hour result). This module is capable of such an output. While the nominal voltage level of the battery will usually be equal to the number of cells times the nominal voltage of each cell (N x 3.7v. The maximum battery voltage may be calculated to be higher than the PCM specification.

H Bridge Inverter- It is composed of multiple units of single-phase H-bridge power cells. The H-bridge cells are normally connected in cascade on their ac side to achieve medium voltage operation and low harmonic distortion. The cascaded H-bridge multilevel inverter requires a number of isolated dc supplies, each of which feeds an H-bridge power cell. Single-phase H structure is shown in Fig.2, which is coupled with the grid through filter inductors. The structure is composed of n series connected H-bridges whose dc sides are connected to a PV module.

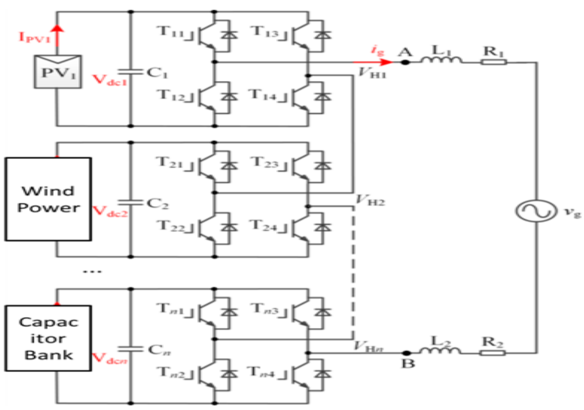

Figure – 2 Schematic diagram of H-inverter

It is composed two inverter legs with two power device in each leg. The inverter dc bus voltage Vdc is usually fixed, while its ac output voltage Vab can be adjusted by either bipolar uni-polar modulation schemes. With different combinations of four switches, each inverter level can generate three different voltages at the output Vdc, Vdc and 0. During inverter operation switches are closed at the same time to provide Vdc a positive value and current path for i0. Switch are turned on to provide Vdc a negative value with a path for depending on the load current angle, the current may flow through the main switch or the freewheeling diodes are connected and parallel with each switch. The amplitude of the modulation waveform is called "MI". And the modulation wave form is shown in figure 3.

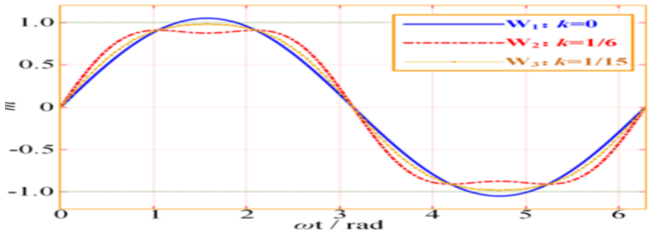

Figure – 3 Modulation waveforms

To synthesize a multilevel waveform, the AC outputs of each of the different level H-bridge cells are connected in series. The cascaded voltage waveform is the sum of the inverter outputs. The number of output phase voltage levels in a cascaded inverter is defined. A five-level output phase voltage waveform can be obtained with two-separated dc sources and four H-bridge cells.

LC Filter-are used either for generating signals at a particular frequency, or picking out a signal at a particular frequency from more complex signal; this function is called a band pass filter.

Inverter-The switching device used here as IGBT for low ON state conduction losses and high switching frequency. The waveform obtained in the output is sine wave bidirectional output because the inverter converts input DC into AC. The switching function of IGBT is done by dsPIC controller with PID control structure. The output may boost up or maintain constant depends on the dsPIC control signal given to the IGBT. The switching pattern is assigned as per the sequence of switching in both the bridges. S_1&S_2 conducts during positive half cycle of output and S_3&S_4 conducts negative half cycle of output. Circuit diagram of inverter with rectifier gives bidirectional mode. During load to source circuit behaves like rectifier and source to load it acts like inverter and the figure 4 shows that the output wave form of the combination of PWM signal, solar input, wind input and the rectifier output with the help of digital signal oscilloscope(DSO).

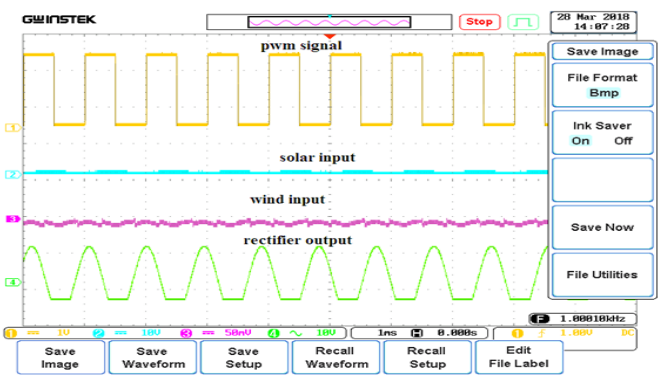

Figure – 4 Output of the controller

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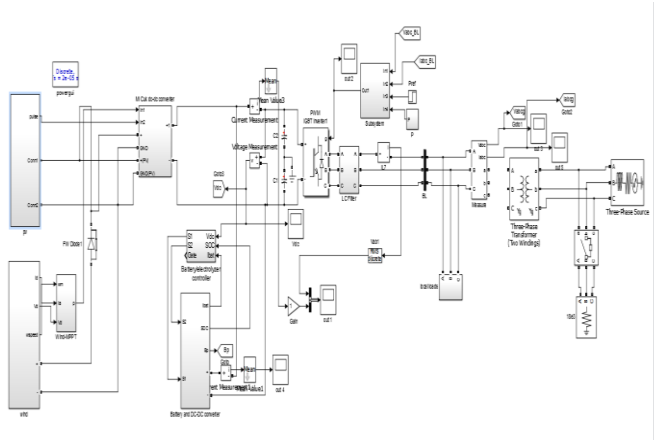

Fig. 5 simulation model of proposed systems

Figure -5 shows that the simulation model for the proposed system and figure -6 shows the simulation model of the PV model. The simulation work is done by the help of MATLAB.

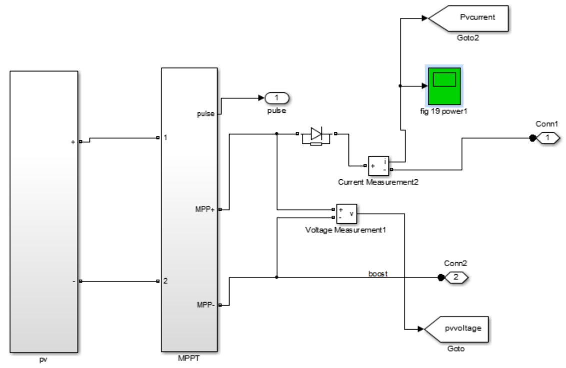

Fig.6 simulation of PV model

IV Conclusion

- ➢ An optimized third harmonic compensation strategy is proposed to improve the linear modulation range of single-phase inverter.
- ➢ Injects the minimum amount of positive third harmonic into inverter by keeping modulation waveform amplitudes of over-modulation cells just being unity, then compensates same amount of negative third harmonic and properly distributes it to the normal cell.
- ➢ The simulation results show that the overall efficiency of the developed inverter is 95% which is more than the conventional inverter.
- ➢ The two-level inverter has produced very high THD.
- ➢ The design of the 5-level multilevel inverters seems to be better than the inverters. By increasing the number of levels, the cost and weight of the inverter will be increased. So that it concludes that the topology is well suited for industrial drives.

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